Claim 19, line 2, delete "computational resource" and insert --active processor--.
line 3, delete "computational resource" and insert --active processor--.

REMARKS

In response to the Office Action dated November 5, 1992, Applicant respectfully requests reconsideration and withdrawal of the rejections of the claims. The courteous interview conducted by Examiner Brown with the Applicant and his representatives is noted with appreciation. The substance of that interview is incorporated in the foregoing amendments to the claims and the following remarks.

Claims 1-4, 7-13, 15 and 18-23 were rejected under 35 U.S.C. §103 as being unpatentable over the Daggett et al '847 patent in view of the Anderson et al patent. With respect to claims 1-4, the rejection alleges that the Daggett et al patent discloses all the features of the claims except for the use of a single computational resource to control the multi-axis machine. Noting this difference, the Office Action alleges that the Anderson et al patent discloses the concept of using a single computational resource, i.e., a micro-computer numeric control system, to provide multi-axis motion control, and concludes that it would be obvious to replace the multi-computational resource of the Daggett et al system with the single computational resource of the Anderson et al patent.

As pointed out in the above noted interview, the Anderson et al patent does not, in fact, disclose the use of a single computational resource to provide multi-axis motion control. The system of the Anderson et al patent comprises a main controller 76, which includes a microprocessor (column 7, lines 57-65). One of the functions of the main

controller is to generate a new set of coordinates every 10 milliseconds. The new coordinates are transmitted to the individual control servos (column 15, lines 36-41). Each servo motor has a motor control board which receives the commands from the controller (column 17, lines 64-68). As stated in the patent, each motor control board "is actually a miniature computer", which includes its own microprocessor (column 18, lines 8-11). Thus, it can be seen that the system of the Anderson et al patent employs multiple processors to provide multi-axis motion control. The motion along each axis is controlled by a microprocessor which is dedicated to that axis. In addition, a separate microprocessor coordinates the motion of the multiple axes. A three-axis system would require four microprocessors in the Anderson et al. arrangement.

The limitations associated with this type of system are overcome by the present invention. More particularly, in a system of the type disclosed in the Anderson et al patent, each of the microprocessors that is dedicated to one of the motors operates for a period of time without any input regarding the other axes of the system. Coordination only occurs when data is received from the main controller. In contrast, in a system such as that recited in claims 1-4, a single processor computes and controls the motion along each of the multiple axes. As a result, the movement along the various axes is inherently coordinated at all times.

During the course of the above noted interview, the Examiner acknowledged this distinction between the present invention and the prior art. He indicated, however, that the terminology "a single computational resource" could be broadly interpreted to read upon a system such as that shown in the Anderson et al patent. More particularly, the

combination of the main controller 76 and the individual motor control boards may be considered to be "a single computational resource", even though it consists of more than one active microprocessor.

As explained to the Examiner, although the described embodiment only discusses the operation of the single processor which controls motion along each of the multiple axes, Applicant is reluctant to define the claimed invention as having only a single processor, for fear that such terminology might be too narrowly interpreted in light of the architecture of modern computer systems. More particularly, the present invention is designed to be run on a personal computer of the type that is prevalent in today's market, such as one which is based upon the Intel 80386 microprocessor. Many personal computers employ additional processors which perform support functions. For example, the keyboard may contain a microprocessor which detects depression of the keys by the user and reports such detection to the main microprocessor. Similarly, the disk drive controller may include a dedicated microprocessor for controlling the reading and writing of information on the disk. Although present in a computer system, these microprocessors do not perform any active role in carrying out functions of the type recited in claims 1-4.

With these arrangements in mind, it was agreed that a term such as "a single active processor" would distinguish the present invention from multi-processor systems of the type shown in the Anderson et al patent, without precluding the presence of support microprocessors whose functions were ancillary to the claimed functions that are

performed by the active processor. Accordingly, it is believed that claims 1-4 are now allowable over the cited prior art.

Claims 1-4 were also rejected under 35 U.S.C. §103 as being unpatentable over the Woodman et al. patent in view of the Anderson et al. patent. It is respectfully submitted that claims 1-4 are patentable over these two references as well, for the same reasons as those set forth above.

Further with respect to claim 4, in the previous response Applicant pointed out how the present invention provides particularly robust control, through the adaptive variation in the center value of the pulse width modulated signal, as recited in claim 4. In response thereto, the most recent Office Action states that the concept of controlling the speed over a range by adjusting the pulse width is discussed throughout the Woodman patent. Contrary to the implications of the Office Action, however, claim 4 does not merely recite the concept of using a pulse width modulated signal to control motor speed. Rather, the claim recites a particular process for generating an adaptive pulse width modulated signal, which includes the steps of determining a center value based on the average width of the signal over plural previous cycles, computing a response based on a position error and/or a velocity error, detecting whether the response is less than or greater than a reference value, increasing the center value when the response is greater than the reference value and decreasing the center value when the response is less than the reference value, and summing the center value and the response to determine the width of the signal. It is not seen where the Woodman patent, or any of the other cited prior art, discloses this particular technique for determining the width of the control

pulses in the motor control signal, particularly the concept of adjusting a center value in accordance with the nature of a computed response.

With respect to claims 7-13, 15 and 18-23, the rejection alleges that columns 58-61 of the Daggett patent disclose that the curve to be followed by a tool is fitted with an appropriate polynomial and the coefficients of the polynomial are stored. It is not seen, however, where any such approach is disclosed at the noted portion of the patent. Rather, this portion of the patent is primarily directed to the computation of a value S, which is "a percentage of the total distance to be traveled in terms of a normalized path length (0-1)" (column 58, lines 24-26). There is no mention in columns 58-61 of the Daggett patent of the concept of fitting a curve to a polynomial, nor storing the coefficients of such a polynomial.

In any event, even if the Daggett et al patent were deemed to implicitly disclose the concept of storing polynomial coefficients, there is no suggestion that the coefficients are used in the manner recited in the rejected claims. For example, claim 7 recites that recursive values for at least position and velocity at the beginning of a cycle are computed from the coefficients, and stored in a table. As further recited in claims 10, 11, and 20, the stored recursive values are recursively summed over successive cycles to compute new position values. None of these concepts are disclosed or otherwise suggested in columns 58-61 of the Daggett et al patent.

Accordingly, it is respectfully submitted that all claims patentably distinguish the present invention from the cited prior art. Reconsideration and withdrawal of the rejections of the claims, and allowance of all pending claims are respectfully requested.

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If the Examiner believes that there are outstanding issues which might be readily resolved, he is invited to contact the undersigned at the number listed below, so that the issues can be discussed and perhaps quickly disposed of to enable the application to be passed to issue.

Respectfully submitted,

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Date: January 11, 1993